

REMARKS

Claims 1-3 and 5-15 are currently pending in the present application. Claims 6-13 have been withdrawn from consideration. Claim 1 has been amended herein. Specifically, with respect to the “at least one silica layer”, the phrase “comprised of a plurality of moniliform silica strings, each comprising a plurality of primary silica particles which are linked in rosary form” has been replaced by the definition of the process for forming the “at least one silica layer”. Support for this amendment is found at page 47, lines 14 to 25 and page 49, lines 14 to 20 of the present specification. Claims 14 and 15 have been amended to correct matters of form. Applicants submit that no new matter has been added by way of the present amendments.

II. Rejection of the claims

II-1. Rejection of claims 1-5, 14 and 15 under 35 USC § 101 and 112

In the outstanding Office Action, the Examiner maintains the rejection of claims 1-5, 14 and 15 under U.S.C. 101 and 112.

Specifically, in response to the Applicants’ argument, the Examiner states that the specification of the present application does not show that the original silica strings (having an average length less than 200 nm) are still present in the resultant porous silica layer.

Applicants respectfully traverse.

As mentioned above, claim 1 has instantly been amended to define the “at least one silica layer” by the production process therefor instead of the phrase “comprised of a plurality of moniliform silica strings, each comprising a plurality of primary silica particles which are linked in rosary form”.

It is believed that the instant amendment to claim 1 has removed the rejection of the claims under 35 USC § 101 and 112. Accordingly, Applicants respectfully request withdrawal of the outstanding rejections.

II-2. Rejection of claims 1-5, 14 and 15 under 35 USC § 102 or 103

In the outstanding Office Action, the Examiner has maintained the rejection of claims 1-5, 14 and 15 under 35 USC § 102 or 103. Specifically, in response to the Applicants' argument that "Lange et al. teaches or suggests neither the moniliform silica strings nor the coating composition comprising the moniliform silica strings, and describes only the use of separate, non-linked silica particles", the Examiner states that the Applicants' argument is erroneous for the following reason:

"Regarding the association between colloidal silica particles, applicants are reminded that the moniliform silica strings of instant invention are prepared according to Watanabe's teaching, and Watanabe discloses that the moniliform silica string is also merely associated silica particles in colloidal state at pH 2-6 [col.7, line 15], which overlaps with the suitable pH range of 3.5-4.0 taught by Lange [col. 5, line 33], consequently applicants' argument that Lange's silence about the formation of moniliform string structure, it is unseen that how the association between silica particles in the same colloidal chemistry is different between Lange and the instant invention, and nowhere has Lange discloses that his silica particles are separate and non-linked."

Applicants respectfully traverse.

Firstly, the Examiner's rejection appears to be premised upon an understanding that Watanabe et al. teach that the formation of moniliform silica strings naturally occurs as long as the pH of a colloidal silica is maintained at 2 to 6, and that the moniliform silica strings are also formed in Lange et al. since Lange et al. describe "suitable pH range of 3.5-4.0" which overlaps with the above-mentioned pH range described in Watanabe et al. However, Applicants respectfully submit that the Examiner has misunderstood the Watanabe et al. disclosure for the following reasons:

(1) contrary to the assertion of the Examiner, Watanabe et al. teach that moniliform silica strings can be formed by a specific 4-step process involving mixing of two different types of silica particles and elevation of the pH from "2 to 6" to "7 to 10";

(2) on the other hand, Lange et al. simply describe such a colloidal silica as used in Watanabe et al. as a raw material for producing moniliform silica strings; and

(3) in addition, Lange et al. suggest that the agglomeration of silica particles used in a coating composition should be prevented.

Therefore, there is no reason to consider that the silica particles in Lange et al. have an unnatural "moniliform" structure instead of the substantially closest packed structure as shown in Fig. 9 of the present application which is physically far more natural structure of packed particles.

On the other hand, the porous silica layer of the silica-containing laminate structure of the present invention has a feature that a large number of large pores as expressed in terms of formula (1) recited in claim 1 of the present application due to the use of moniliform silica strings. By virtue of this feature, the laminate structure of the present invention is advantageous in that the porous silica layer has not only low refractivity and high light transmittance but also high strength, so that the laminated structure can be advantageously used as an antireflection material, such as an antireflection film. Therefore, it is apparent that the silica-containing

laminated structure of the present invention is not anticipated by Lange al. or obvious over Lange et al. in view of Watanabe et al. More specific explanations are made below.

With respect to Watanabe et al., in an attempt to provide a silica sol suitable for use in a “coating composition for an ink receiving layer”, this prior art reference has developed a “moniliform silica sol and a method for producing it” (see, for example, col. 1, lines 8 to 21). However, Watanabe et al. by no means teach or suggest that the moniliform silica strings are obtained simply by maintaining the pH of colloidal silica at “pH range of 3.5-4.0” but, rather, teach that the moniliform silica strings are formed by a specific 4-step process as recited in claim 2 thereof, which comprises steps (a) to (d). Specifically, as can be seen from claim 2 of Watanabe et al., this reference teaches that the moniliform silica particles having a particle diameter D_1 (measured by the dynamic light scattering method as in the case of the “average length” measured in the present invention) of 50 to 500 nm are formed by a process comprising:

(a) adding an aqueous solution containing one or more compounds selected from the group consisting of water-soluble II valent metal salts and water-soluble III valent metal salts to an active silicic acid having an SiO_2 concentration of 0.5 to 10% by weight and a pH of 2 to 6 or an acidic silica sol having a mean particle diameter of 3 to 8 nm, an SiO_2 concentration of 0.5 to 10% by weight and a pH of 2 to 6, in an amount of 1 to 10% by weight as a metal oxide (MO in the case of the II valent metal salt and M_2O_3 in the case of the III valent metal salt, wherein M represents a II valent or III valent metal atom and O represents an oxygen atom) based on SiO_2 in said active silicic acid-containing aqueous colloid liquid or said acidic silica sol, and mixing them;

(b) adding an acidic spherical silica sol having a mean particle diameter of 10 to 80 nm and a pH 2 to 6 to the mixed liquid (a) obtained in the step (a), a weight ratio (A/B) of a silica content (A) (as derived from said acidic spherical silica sol) to a silica content (B) (as derived from the mixed liquid (a)) of 5 to 100, to an SiO_2 concentration of 5 to 40% by weight as a total silica content (A+B), and mixing them;

(c) adding one compound selected from the groups consisting of alkali metal hydroxides, water-soluble organic bases and water-soluble silicates to the mixed liquid (b) obtained in the step (b) to a pH of 7 to 11, and mixing them; and

(d) heating the mixed liquid (c) obtained in the step (c) at 100 to 200 °C. for 0.5 to 50 hours.

With respect to this 4-step process, at col.10, line 40 to col. 11, line 41, Watanabe et al. explain the mechanism of forming the moniliform silica particles. The mechanism is as follows. In step (a), colloidal silica particles (pH of 2 to 6; a mean particle diameter of 3 to 8 nm) “which are totally negatively charged on their surface but partially positively charged” is prepared, and such colloidal silica particles are combined in step (b) with negatively charged colloidal silica particles (pH of 2 to 6; a mean particle diameter of 10 to 80 nm). Then, in step (c), the pH of the resultant colloidal silica mixture is increased to “7 to 9” to thereby cause the coagulation (including moniliform aggregation) of the silica particles; however, at this stage, the silica particles are not bound to each other. Finally, in step (d), the mixture prepared in step (c) is heated so that the silica particles are bound to each other, thereby obtaining moniliform silica particles. For easy reference, the explanations in Watanabe et al. are reproduced below.

“First, in the step (a), when a water-soluble II valent metal salt or a water-soluble III valent metal salt is added singly or in admixture to an active silicic acid-containing aqueous colloid solution of having a pH of 2 to 6 or an acidic silica sol having a mean particle diameter of 3 to 8 nm, the II or III valent metal ions are captured by the silanol groups on the surface of the colloid of active silicic acid or of colloidal silica particles having a mean particle diameter of 3 to 8 nm. That is, in the mixed liquid (a) obtained by the step (a), the colloid of active silicic acid or colloidal silica particles having a mean particle diameter of 3 to 8 nm are totally negatively charged on their surface but partially positively charged.

In the step (b), when acidic spherical silica sol having a mean particle diameter of 10 to 80 nm and a pH of 2 to 6 is added to the mixed liquid (a) obtained by the step (a), the colloid of active silicic acid or colloidal silica particles having a mean particle diameter of 3 to 8 nm, partly positively charged, obtained by the step (a) are electrically or physically adsorbed onto the surface of negatively charged colloidal silica particles having a mean particle diameter of 10 to 80 nm. In this stage, no coagulation in a moniliform shape has generated.

In the step (c), when the alkali metal hydroxide, water-soluble organic base or water-soluble silicate is added to the mixed liquid (b) obtained in the step (b) such that pH is 7 to 11, the colloidal silica particles having a mean particle diameter of 10 to 80 nm having adsorbed thereon the colloid of active silicic acid or colloidal silica particles having a mean particle diameter of 3 to 8 nm obtained by the step (b) and having partially positive charges on the surface thereof adsorb alkali metal ions or organic bases through the silanol groups thereof and causes coagulation in the presence of the II or III valent metal ions. The coagulation includes moniliform aggregation and three-dimensional gel-like aggregation. However, in this stage, the colloid is not bound.

In the step (d), the colloidal silica particles in the mixed liquid (c) obtained in the step (c) will change at an increasing temperature such that the three-dimensional silica gel is peptized to form silica sol and moniliform coagulation proceeds in only one plane, and the spherical colloidal silica particles having a mean particle diameter of 10 to 80 nm and the colloid of active silicic acid or colloidal silica particle having a mean particle diameter of 3 to 8 nm bond to each other by dehydration-condensation. On this occasion, due to the balance between the spherical colloidal silica particles having a mean particle diameter of 10 to 80 nm and the colloid of active silicic acid containing a metal oxide or colloidal silica particles having a mean particle diameter of 3 to 8 nm that bond the spherical colloidal silica particles, and as a result of a series of processes, moniliform colloidal silica particles in which spherical colloidal silica particles having a mean particle diameter of 10 to 80 nm linked in rows in only one plane and have each a particle diameter of 50 to 500 nm measured by the dynamic light scattering method and have 3 or more in the terms of the ratio are produced.” (emphasis added) (col.10, line 52 to col.11, line 41).”

Thus, Watanabe et al. teach that the colloidal silica particles should be subjected to various reactions and treatments before moniliform silica strings are formed. Further, it should be noted that, during steps (a) and (b) where silica sols used are acidic (pH of 2-6), “no coagulation in a moniliform shape has generated”, whereas, in step (c) where the pH of the system is increased to 7 to 11, coagulation is caused in the presence of the II or III valent metal ions, which coagulation includes “moniliform aggregation”.

As apparent from the discussion above, the unique “moniliform” structure would not be naturally formed simply by adjusting the pH of a silica sol but, rather, should be intentionally formed by a specific method as described in Watanabe et al. Unless such specific method is used, the silica particles (i.e., primary silica particles) are not agglomerated to form the unique “moniliform” structure, but are naturally agglomerated in substantially closest packed form as shown in Fig. 9 of the present application, which shows a porous silica layer formed by coating on a PET substrate a coating composition containing separate, non-linked silica particles.

Therefore, it is apparent that the Examiner’s conclusion that “Watanabe discloses that the moniliform silica string is also merely associated silica particles in colloidal state at pH 2-6” is improper.

With respect to Lange et al., this reference has no teaching or suggestion about such a method for forming moniliform silica strings as described in Watanabe et al. As apparent from the above explanations in Watanabe et al., moniliform silica strings cannot be formed simply by adjusting the pH of silica sol at 2-6. Lange et al. simply describe the use of a solution containing colloidal silica particles having an average primary particle size less than about 200 Å (i.e., 20 nm) (see, for example, col. 5, lines 1 to 7 of Lange et al.). That is, Lange et al. simply describes such colloidal silica particles as used in steps (a) and (b) of Watanabe et al. as a raw material of the moniliform silica strings.

Further, it should be noted that Lange et al. attempt to prevent the agglomeration of silica particles used for preparing a coating composition as apparent from the following description:

“The colloidal solution, finely divided solid silica particles of ultramicroscopic size in a liquid, utilized in the present invention, may be acid stabilized, sodium stabilized, or ammonia stabilized. It is especially helpful to acidify sodium stabilized silica sols to a pH of about 3.5 to 4.0, e.g., with glacial acetic acid, to prevent particle agglomeration prior to preparation of the coating solution when alcohol is used as a diluent.” (emphasis added)(col. 5, lines 28 to 36).”

Thus, Lange et al. have no teaching or suggestion about the formation of moniliform silica strings but, rather, teach away from the use of agglomerated silica particles, such as moniliform silica strings, in a coating composition for producing an antireflection film.

From the above, it is apparent that Lange et al. describe only the use of separate, non-linked silica particles. Needless to say, when separate, non-linked silica particles (having a primary particle size of less than 20 nm) used in Lange et al. are agglomerated in substantially closest packed form as shown in Fig. 9 of the present application, it is impossible to obtain a silica layer having a large number of large pores such that the formula (1) “ $(S_{(a2+3\sigma)})/(S) \geq 0.5$ ” is satisfied. This is clearly substantiated in the Comparative Examples of the present application as already discussed in the Applicants’ previous response (see page 16, 2nd paragraph to page 19 of the response filed on January 26, 2007).

Further, with respect to the technique using such separate, non-linked silica particles, as already discussed in the Applicants’ previous response referring to the Examples and Comparative Examples of the present application, there is a trade-off between the optical properties (such as refractivity and light transmittance) and the strength (see page 16, 2nd paragraph to page 19 of the response filed on January 26, 2007).

Specifically, in the present invention, by the use of the moniliform silica strings, the laminate structure of the present comprises a porous silica layer has a large number of large pores such that the formula (1) " $(S_{(a2+3\sigma)})/(S) \geq 0.5$ " is satisfied. By virtue of this feature, the laminate structure of the present invention is advantageous in that the porous silica layer has not only low refractivity and high light transmittance but also high strength, so that the laminated structure can be advantageously used as an antireflection material, such as an antireflection film (page 1, lines 19 to 25 of the present specification).

On the other hand, by the use of separate, non-linked silica particles as used in Lange et al., as shown in Comparative Examples 4 and 5 of the present application, the silica layer formed is a continuous gelled network formed by the separate, non-linked silica particles as shown in Fig. 9 of the present application and, hence, has only a very small amount of large pores. The porous silica layer obtained using such separate, non-linked silica particles has either poor hardness or poor reflectance.

Therefore, it is apparent that the present invention is not anticipated by Lange et al.

In addition, it should be noted that neither Lange et al. nor Watanabe et al. have any teaching or suggestion that the moniliform silica strings as described in Watanabe et al. is effective for forming an antireflection film. Rather, as mentioned above, Lange et al. suggest that the presence of agglomerate silica particles, such as moniliform silica strings, should be avoided. Therefore, the present invention is not obvious over Lange et al. in view of Watanabe et al.

From the discussion above, it is apparent that the present invention is neither anticipated by nor obvious over Lange et al.

III. Conclusion

From the foregoing, it is firmly believed that all rejections of the claims have been overcome. Early and favorable action is respectfully solicited.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Monique T. Cole, Reg. No. 60,154 at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.14; particularly, extension of time fees.

In view of the above amendment, applicant believes the pending application is in condition for allowance.

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Respectfully submitted,

By

John W. Bailey

Registration No.: 32,881

BIRCH, STEWART, KOLASCH & BIRCH, LLP

8110 Gatehouse Road

Suite 100 East

P.O. Box 747

Falls Church, Virginia 22040-0747

(703) 205-8000

Attorney for Applicant

MTC